Research Project Report

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Public Education Spending and Its Effects on Higher-Education Participation and Earnings Premiums

1. Introduction

Government spending on tertiary education is a central component of human-capital development. Across OECD economies, educational attainment decisions shape labor-market outcomes, while public investment can influence access to higher education and the capacity of tertiary institutions to deliver education at scale.

The COVID-19 shock plausibly altered tertiary enrollment decisions because higher education is a discretionary choice and, relative to compulsory schooling, often relies more heavily on household spending and student-aid arrangements. In such settings, enrollment may become more sensitive to short-run income risk and liquidity constraints. Financing regimes that require substantial upfront payments at the point of enrollment may therefore be particularly vulnerable to enrollment shocks, whereas income-contingent loan systems—where students do not pay upfront—may be more resilient (OECD, 2021).

In the post-COVID period, countries also differed markedly in their public funding responses. OECD (2021) documents widespread adjustments in higher-education public budgets in 2020/2021 and highlights that expansions in student support—such as student grants/scholarships and student loans—were common elements of these responses. This cross-country heterogeneity in the intensity of public spending adjustments provides a useful setting to examine whether larger post-COVID spending responses are associated with different trajectories of tertiary enrollment.

This study investigates two interrelated questions:

1. How relative earnings differ across education levels.
2. Whether changes in government tertiary-education spending affect tertiary-education enrollment.

2. Research Design

To answer these questions, I combine correlational methods with a Difference-in-Differences (DiD) design that exploits observed cross-country variation in post-COVID changes in per-student government spending on tertiary education across OECD countries. The correlational analysis is used to describe earnings differences across education levels, while the DiD framework provides a policy-evaluation approach to assess whether countries with larger post-2020 spending adjustments experienced differential post-2020 trajectories in tertiary enrollment relative to countries with smaller adjustments.

2.1 Identification Strategy

Two empirical strategies are implemented to capture both discrete and continuous dimensions of spending adjustments.

(1) Difference-in-Differences Design

The first strategy classifies countries into **high-response** and **low-response** groups based on whether their 2020–2021 increase in per-student tertiary-education spending exceeds the sample median. The Difference-in-Differences (DiD) framework compares the evolution of tertiary-enrollment rates between these two groups before and after 2021, the first full year after the initial 2020 shock.

This approach follows the logic of policy evaluation designs in which a subset of units experiences a more substantial treatment response than others. The identifying assumption is that, absent differential spending increases, enrollment trends in high- and low-response countries would have followed similar trajectories.

To examine the validity of the identifying assumption and to characterize dynamic patterns, an event-study specification is also estimated. This event-time framework provides a flexible representation of pre- and post-2021 differences and allows visualization of treatment dynamics, including whether any divergence emerges only after 2021.

Importantly, this design does not assume that funding adjustments were mechanically caused by enrollment changes. Instead, it treats the 2020–2021 spending change as a heterogeneous funding-policy response across countries and estimates whether enrollment evolved differently in countries with larger versus smaller adjustments, conditional on fixed effects and pre-trend diagnostics.

(2) Continuous-Treatment Approach

While the binary DiD design focuses on average differences between country groups, the second strategy analyzes the *magnitude* of spending adjustments. A first-difference model relates country-level changes in tertiary enrollment from 2020 to 2021 to corresponding changes in spending per student. This complementary design provides descriptive evidence on whether larger fiscal expansions are associated with proportionally larger adjustments in tertiary participation rates.

Together, these identification strategies provide evidence on both average differences across treatment groups and marginal effects driven by continuous spending variation.

3. Data

The empirical analysis uses a multi-country panel dataset containing annual information on tertiary enrollment ratios, government education spending, and long-run pre-COVID trends. This section describes the data sources, key variables, and sample construction.

3.1 Data Sources

In practice, the empirical dataset is constructed from publicly available series accessed via Our World in Data (OWID) Grapher downloads for tertiary gross enrollment ratios and government funding per tertiary student.

The primary variables are obtained from international education and public-expenditure databases:

- **Tertiary enrollment ratio**: measured as gross tertiary enrollment (% of relevant age cohort).
- **Government tertiary-education spending per student**: expressed as public spending per tertiary student (in constant units).
- **Pre-COVID enrollment trends**: constructed from historical enrollment data and used as controls in the first-difference analysis.

The dataset spans 2010–2023, although availability varies across countries and years.

3.2 Sample Construction

The analytic sample includes countries with non-missing observations for tertiary enrollment and spending variables around the COVID period. Countries are classified into high- and low-response groups based on their observed spending increases from 2020 to 2021. Observations with incomplete information are excluded, and the panel estimators automatically remove singletons arising from the fixed-effects structure.

3.3 Key Variables

The analysis focuses on three key variables related to tertiary education outcomes and public investment.

Outcome

- **Tertiary Enrollment Ratio**: the gross tertiary enrollment rate serves as the primary dependent variable in both the panel and first-difference models.
- **Relative Earnings Index (Tertiary Education)**: measures average earnings of tertiary-

educated workers relative to individuals with upper-secondary education and captures labor-market returns to higher education. The relative earnings index is included to contextualize enrollment decisions, as higher expected labor-market returns may moderate the short-run responsiveness of tertiary enrollment to public spending shocks.

Treatment

Two alternative treatment definitions are used: a binary treatment for the Difference-in-Difference analysis and a continuous spending measure for analysis.

- **Binary treatment assignment** (`Treated_c`): Indicator for above-median spending increase.

- **Post indicator** (`Post_t`): Equals 1 for years $\geq$ 2021.

- **Interaction** (`Treated_c × Post_t`): Captures differential post-2021 enrollment changes.

Continuous treatment

- **ΔSpending**: Year-to-year change in per-student tertiary spending.

- **ΔEnrollment**: Corresponding change in tertiary enrollment.

- **Pretrend**: Long-run pre-COVID enrollment trend included as a control.

Variable Name	Description	Source
Enrollment	Gross enrollment ratio for tertiary education (both sexes)	Our World in Data (OWID)
Spending	Government expenditure per tertiary student (PPP$)	Our World in Data (OWID)
Earnings	Relative earnings index (Tertiary)	OECD Education at a Glance
Treated	Indicator for countries with high post-COVID spending growth	Calculated from OWID

Table 2: Summary Statistics for Key Variables (OECD Countries)

Variable	N	Mean	SD	P25	P50	P75
Tertiary Enrollment Rate (%)	28	114.17	14.85	104.02	109.29	119.45
Gov. Spending per Student (PPP$)	28	18155.87	12113.69	10051.68	15589.46	22435.17

Relative Earnings Index (Tertiary)	28	75.43	4.34	72.50	76.00	78.25

Table 2 reports summary statistics for tertiary enrollment, government spending per tertiary student, and relative earnings across OECD countries. On average, tertiary enrollment rates exceed 100 percent, reflecting the use of gross enrollment measures that account for international students and non-traditional age cohorts. Government spending per tertiary student shows substantial cross-country variation, with a wide interquartile range, highlighting heterogeneity in public investment intensity. The relative earnings index indicates a sizeable earnings premium for tertiary-educated workers, consistent with strong labor-market returns to higher education across OECD economies.

4. Methodology

This section presents the empirical models used to estimate the relationship between government spending and tertiary enrollment. Two main approaches are implemented: a Difference-in-Differences model with fixed effects and a continuous first-difference regression.

4.1 Baseline Difference-in-Differences Specification

The primary estimating equation is:

$$Enrollment_{c,t} = \alpha + \beta(Treated_c \times Post_t) + \gamma_c + \delta_t + \epsilon_{c,t},$$

where:

- $Enrollment_{ct}$ is the gross tertiary enrollment rate for country i in year t.
- $Treated_i$ is a dummy variable equal to 1 if a country increased education spending above the OECD median for the period 2021.
- $Post_t$ is a dummy variable post-2020.
- γ_c are country fixed effects that absorb time-invariant differences across countries.
- δ_t are year fixed effects that account for global shocks and common time trends, standard errors are clustered at the country level to allow for arbitrary within-country serial correlation.
- The coefficient β captures the differential post-2021 change in tertiary enrollment for high-response countries relative to low-response countries.

4.2 Event-Study Specification

To examine pre-treatment alignment and treatment dynamics, a flexible event-time model is estimated:

$$Enrollment_{c,t} = \alpha + \sum_{k \neq -1} \beta_k \cdot \mathbf{1}(t - 2021 = k) \cdot Treated_c + \gamma_c + \delta_t + \epsilon_{c,t}.$$

The coefficients β_k trace annual differences between treated and control countries relative to the year immediately preceding 2021. This specification enables visualization of whether enrollment trends diverge only after the spending shock.

4.3 Continuous First-Difference Model

To assess whether the size of spending adjustments relates to short-run enrollment changes, a first-difference regression is estimated:

$$\Delta Enrollment_c = \alpha + \beta\,\Delta Spending_c + \theta\,Pretrend_c + \epsilon_c.$$

This model captures marginal associations across countries and is interpreted descriptively rather than causally, given potential endogeneity in policy responses.

4.4 Summary of Empirical Approach

Table 3: Summary of Research Methodology and Identification Strategy

Method	Purpose	Key.Variables
Difference-in-Differences (DiD)	Estimate the average treatment effect of high spending on enrollment rates.	Treated, Post, Enrollment
Event Study Analysis	Test the parallel trends assumption and observe dynamic effects over time.	Year Dummies, Treated, Enrollment
First-Difference Regression	Analyze the short-run correlation between annual changes in spending and enrollment.	Δ Spending, Δ Enrollment

Together, these models provide a coherent framework for evaluating whether post-COVID education-spending responses translated into changes in tertiary participation.

5. Results

This section presents descriptive evidence on changes in tertiary enrollment and government spending, followed by the main empirical results using the Difference-in-Differences and continuous first-difference approaches. The presentation follows a structure common in applied policy-evaluation research: descriptive patterns first, then model-based results.

5.1 Descriptive Patterns

To motivate the analysis, Figure 1 displays average tertiary-enrollment trajectories for high-response and low-response countries, where high-response countries are those with above-median increases in per-student tertiary-education spending between 2020 and 2021.

Prior to 2021, the two groups display broadly similar movements in average enrollment, with no clear and persistent divergence. Around the onset of the pandemic, the gap between groups widens from 2019 to 2020, as the high-response group's average enrollment increases more. By 2021, both groups rise further, but the difference in raw group means slightly narrows relative to 2020. These descriptive patterns are based on unconditional group averages and do not incorporate uncertainty or compositional differences; the subsequent DiD and event-study estimates formally assess whether post-2021 differential changes are statistically distinguishable from zero once country and year fixed effects are included.

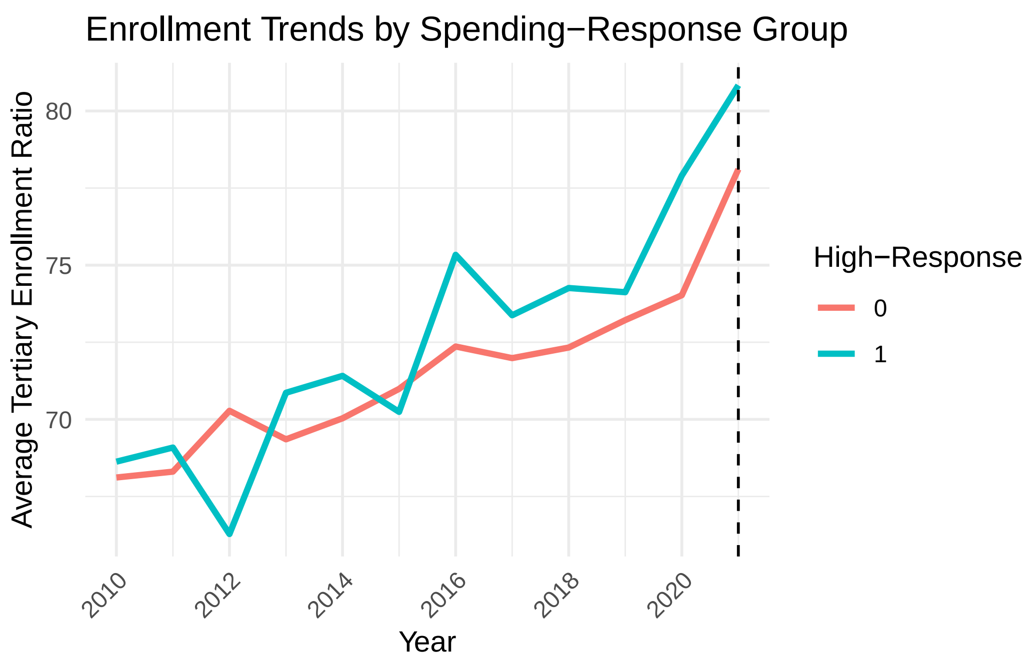

Figure 1: Average tertiary enrollment for high-response and low-response OECD countries.

5.2 Difference-in-Differences Estimates

Table 4 reports the baseline Difference-in-Differences estimates described in Section . The coefficient on the interaction term

$Treated_c \times Post_t$

captures the differential change in tertiary-enrollment levels for high-response countries relative to low-response countries after 2021.

The estimated effect is small and statistically insignificant, indicating **no evidence that countries**

with larger post-COVID spending increases experienced faster short-run enrollment growth. This finding aligns with the descriptive patterns in Section 5.1.

Table 4

term	estimate	std.error	statistic	p.value	conf.low	conf.high
treated:post	0.21	2.403	0.087	0.931	-4.679	5.099

5.3 Event-Study Dynamics

To examine dynamic treatment effects and assess the parallel-trends assumption more explicitly, Figure 2 plots the coefficients from the event-time specification introduced in Section .

Pre-treatment coefficients fluctuate around zero with wide confidence intervals, providing no indication of systematic divergence prior to 2021. Post-treatment coefficients also remain close to zero and statistically indistinguishable from pre-treatment values.

Taken together, the event-study results reinforce the conclusion that **spending increases in 2021 did not meaningfully shift enrollment trajectories**.

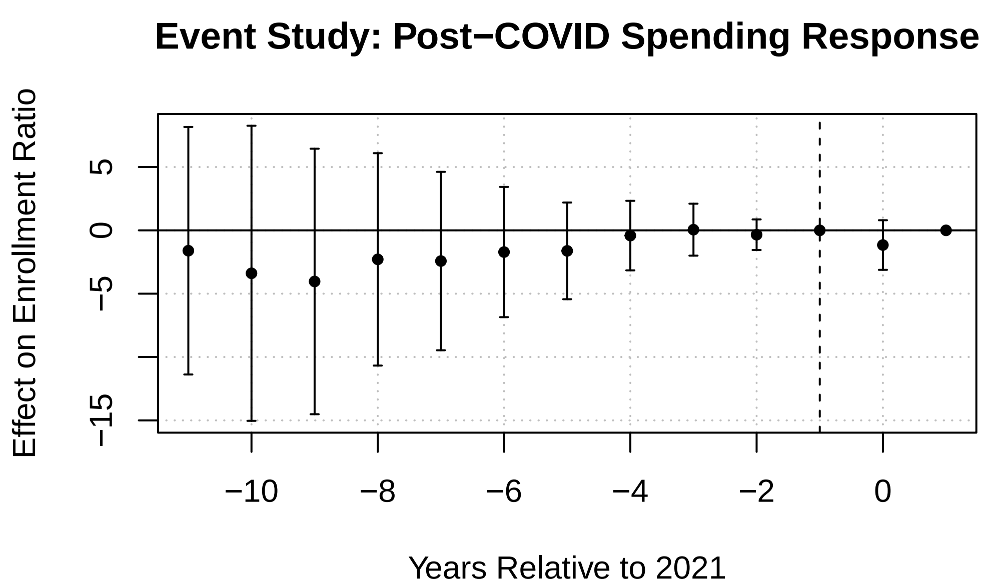

Figure 2: Event-study coefficients relative to 2021 (reference year = 2020).

5.4 Continuous First-Difference Estimates

The first-difference model estimated is:

Table 5: Regression of 2021–2020 enrollment changes on spending changes.

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	3.446	0.520	6.623	0.000	2.383	4.509
spend_change	0.000	0.000	-1.728	0.094	-0.001	0.000
pretrend	0.096	0.288	0.332	0.742	-0.492	0.683

$$\Delta Enrollment_c = \alpha + \beta\, \Delta Spending_c + \theta\, Pretrend_c + \epsilon_c.$$

Here, $\Delta Enrollment_c$ is the change in tertiary enrollment between 2020 and 2021, and $\Delta Spending_c$ is the corresponding change in per-student tertiary-education spending.

The estimated coefficient on spending change is **negative and marginally significant at the 10% level**. Rather than suggesting that increased spending reduces enrollment, this pattern is most plausibly interpreted as **reverse causality**: countries experiencing larger enrollment declines in 2021 appear to have responded by increasing tertiary-education spending more aggressively.

This interpretation is consistent with the absence of positive effects in the DiD and event-study analyses.

5.5 Summary of Findings

Across all empirical strategies—descriptive comparisons, Difference-in-Differences, event-study analysis, and first-difference regression—the evidence shows **no short-run impact of increased tertiary-education spending on enrollment rates** following the COVID-19 shock. High-response countries did not exhibit distinct post-2021 enrollment patterns, and the DiD and event-study coefficients remain small and statistically insignificant. The negative association in the first-difference model is best interpreted as **reverse causality**, reflecting governments' responses to declining enrollment rather than causal effects of higher spending.

Overall, the findings indicate that **post-COVID spending increases did not produce immediate gains in tertiary-education participation**, with observed correlations driven by reactive policy adjustments rather than changes in student behavior.

6. Discussion & Conclusion

This study finds:

1. Strong positive earnings gradients across education levels.

2. No evidence of an immediate (short-run) increase in tertiary enrollment following larger post-COVID spending increases; the first-difference association is more consistent with reactive

policy responses (reverse causality) than with a causal enrollment effect.

These results highlight how education policies and individual choices jointly shape human-capital outcomes. Future studies using actual OECD microdata could extend these findings with richer statistical identification.

References

OECD. (2021). *The state of higher education: One year into the COVID-19 pandemic*. OECD Publishing.